RESEARCH CIRCULAR 82 FEBRUARY 1960

OHIO AGRICULTURAL EXPERIMENT STATION

WOOSTER, OHIO

SOME FACTORS INFLUENCING COLD SOAKING OF FENCE POSTS

WAYNE K. MURPHEY

Publications concerned with farm treatment of posts by the cold soaking method usually state time of soak and species as the two important variables when treating by the cold soaking method. Recommendations are generally stated as number of hours required for certain species to absorb satisfactory amounts of preservative. An experiment conducted in 1953 at the Ohio Agricultural Experiment Station concerned with time of soak and species showed that not all species retained sufficient amounts of treating solution to produce a test of the effectiveness of the preservative.[1]

In order to evaluate some of the factors which influence retention and penetration of oil borne preservatives, an experiment was initiated using red pine and white pine posts. Two oil-borne preservatives and four methods of peeling were studied. The posts were removed from a treating solution when either a definite amount of preservative was absorbed or the post would not absorb any more of the solution.

Procedure

Red pine and white pine posts were soaked in 0.50 percent copper naphthenate or 5 percent pentachlorophenol in No. 2 fuel oil until they had absorbed a designated amount of preservative or until the saturation point was reached.

Prior to treatment the posts were peeled by the hand, sap, bug, or chemical method. The condition of the hand- and sap-peeled posts was similar and therefore they were grouped in the same charge. The chemically-peeled posts were obtained by treating live trees with sodium arsenite in order to facilitate the removal of bark. Bug-peeled posts were cut in the winter and piled on end in the shade. By the following summer insects and weathering had loosened or destroyed the bark. At

[1]Murphey, W. K. 1955. Large variations in absorption results when cold soaking poorly seasoned posts. Forestry Mimeo. #24, OAES, June, 1955

the time of treatment it was found that the condition of the chemically-peeled posts was similar to those that were bug-peeled. Consequently, the posts which had been hand- and sap-peeled were treated as another group. Four charges of 12 posts were treated in each preservative solution. Each charge consisted of hand- and sap-peeled posts of the same species or bug- and chemically-peeled posts of the same species.

The red and white pine posts had moisture content ranging between 13 and 15 percent as obtained by an electric moisture meter with two-inch electrodes. These moisture determinations were checked by calculating moisture content by the oven-dry method on increment cores from 4 posts from each charge of 12 posts. Since there was no difference greater than 0.2 percent between the electric moisture meter reading and the cores, the posts were considered to have a moisture content as read from the meter. These posts may be considered as dry and essentially equal in moisture content for the purpose of this study.

The treating tank, Figure 1, was calibrated by the following means: increments of 50 pounds of the treating solution were added to the tank and the height of the liquid on a vertical scale was recorded. A graph was drawn from the resulting data and computations for volumetric increments were made. The height of the solution in the tank was recorded before the posts were placed in the solution and again after the posts were submerged. The volume of the charge was then determined by the difference in height of the solution. This volume was checked against the measured total volume of the individual posts. The weight of preservative to be absorbed by the total charge was calculated and

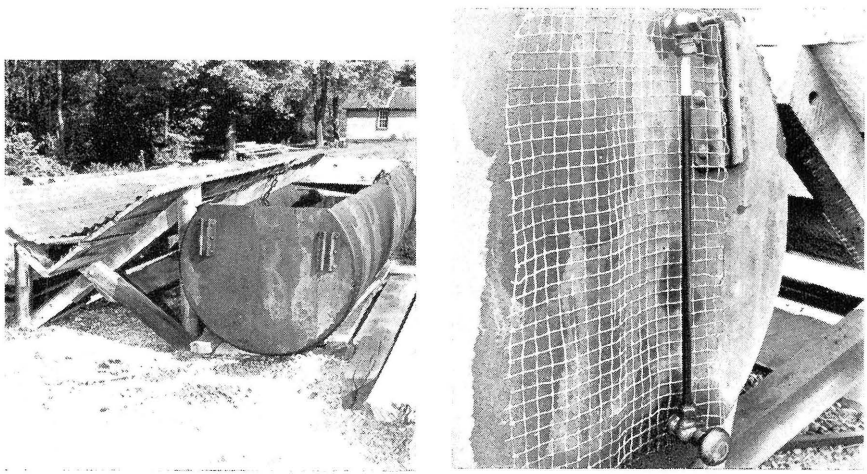

Fig. 1.—Left, treating tank and drain rack. Right, calibration equipment on outside of treating tank. A scale was used to determine preservative levels.

TABLE 1.—Penetration and Retention of Preservative in Two Species of Pine Posts

Species	Method of Peeling	Time soaked (Hrs.)	Retention			Penetration of Sapwood		Preservative
			Desired	Actual	Indicated	In.	%	
			Average Standard Deviation (#/cubic foot)					
Red pine								
	Chemical	52	8	12.62 ± 1.12	9.5	1.2	100	Copper Naphthenate
	Bug	4	8	12.62 ± 1.12	9.5	1.2	100	Pentachlorophenol
	Chemical	4	8	6.08 ± 2.47	9.5	1.2	100	Copper Naphthenate
	Sap	52	8	3.71 ± 0.11	3.7	0.8	80	Copper Naphthenate
	Hand	52	8	3.61 ± 0.78	3.7	0.7	88	Copper Naphthenate
	Bug	3	8	12.40 ± 3.54	9.2	1.3	100	Pentachlorophenol
	Chemical	3	8	5.83 ± 4.18	9.2	1.1	85	Pentachlorophenol
	Sap	58	8	3.96 ± 0.12	4.2	0.6	70	Pentachlorophenol
	Hand	58	8	4.40 ± 0.81	4.2	0.7	75	Pentachlorophenol
White pine								
	Bug	4	6	4.75 ± 2.36	6.1	0.9	95	Copper Naphthenate
	Chemical	4	6	4.67 ± 1.21	6.1	0.9	90	Copper Naphthenate
	Sap	52	6	2.07 ± 0.58	2.1	0.3	40	Copper Naphthenate
	Hand	52	6	1.87 ± 0.54	2.1	0.2	40	Copper Naphthenate
	Bug	4	6	4.26 ± 3.0	6.0	0.9	85	Pentachlorophenol
	Chemical	4	6	5.16 ± 2.41	6.0	0.9	90	Pentachlorophenol
	Sap	58	6	1.94 ± 0.30	2.1	0.3	45	Pentachlorophenol
	Hand	58	6	2.06 ± 0.59	2.1	0.3	50	Pentachlorophenol

the resultant liquid height in the tank determined. When this height was reached or when the posts did not absorb any more solution, the posts were removed from the tank and weighed individually to determine uptake of each post. The total time of treatment was noted.

Weights and cubic measurements were taken before the posts were submerged. After soaking, the posts were allowed to drain and wiped dry prior to the second weighing. Pounds of preservative per cubic foot of wood was calculated and increment borings were taken from three points near the center of the post to determine penetration.

Results

The condition of the posts apparently had a greater influence on preservative absorption than did time or preservative. The posts which had been bug-peeled and chemically-peeled absorbed more preservative

in a shorter time than the hand- or sap-peeled posts. This was due to the number of small insect holes in the sapwood of the bug- and chemically-peeled posts which exposed a larger portion of end grain. Thus more end surface was present for longitudinal diffusion of the treating solution.

In the case of red pine posts, the grouping of bug- and chemically-peeled posts had an effect on the total pick-up of the charge. The bug-peeled posts absorbed about twice as much preservative as the chemically-peeled posts. The individual retentions of posts in this charge ranged from 8.9 to 17.0 pounds per cubic foot for bug-peeled posts, and from 3.9 to 12.8 pounds per cubic foot for the chemically-peeled posts. Since the white pine insect-attacked posts absorbed approximately the same amount of preservative, grouping of the bug- and chemically-peeled posts is considered valid. In this case the time of soak for both conditions of peeling is considered the same.

The red pine bug-peeled posts would not have required the same length of soaking time. As can be seen by the deviation in the insect attacked posts of both species, posts peeled under such conditions differ enough to warrant examination of treating procedure. In order to insure adequate treatment of all posts, over-treatment of some posts is necessitated. This raises the treatment costs without appreciably adding to service life. The deviation from the mean of insect attacked posts indicates a large difference in the condition of the post.

Since moisture content and species are the same and no real difference existed between preservatives, the peeled condition of the post remains as the cause for such a wide range of retentions (Figure 3). This, then would eliminate positive recommendations concerning bug-peeling as a method of bark removal. Unfortunately, since the chemically-peeled posts were attacked by insects, no conclusions may be drawn as to the effectiveness of this method of peeling.

The hand- and sap-peeled red and white pine posts did not absorb the desired amounts of preservatives. The results showed no real differences between the two preservatives used in this study. This may be attributed to four factors: the species, method of peeling, the growth rate of the post, and method of treating. Both of the species used in this test are considered to be relatively easy to treat by cold soaking. The Forest Products Laboratory of the U. S. Department of Agriculture lists them in the class of post with which retentions can be expected to be fair to good and penetrations can be expected to be reasonably good. Since these posts did not reach the specifications for treated posts in retention or penetrations, it can be assumed that factors other than species influenced the results.

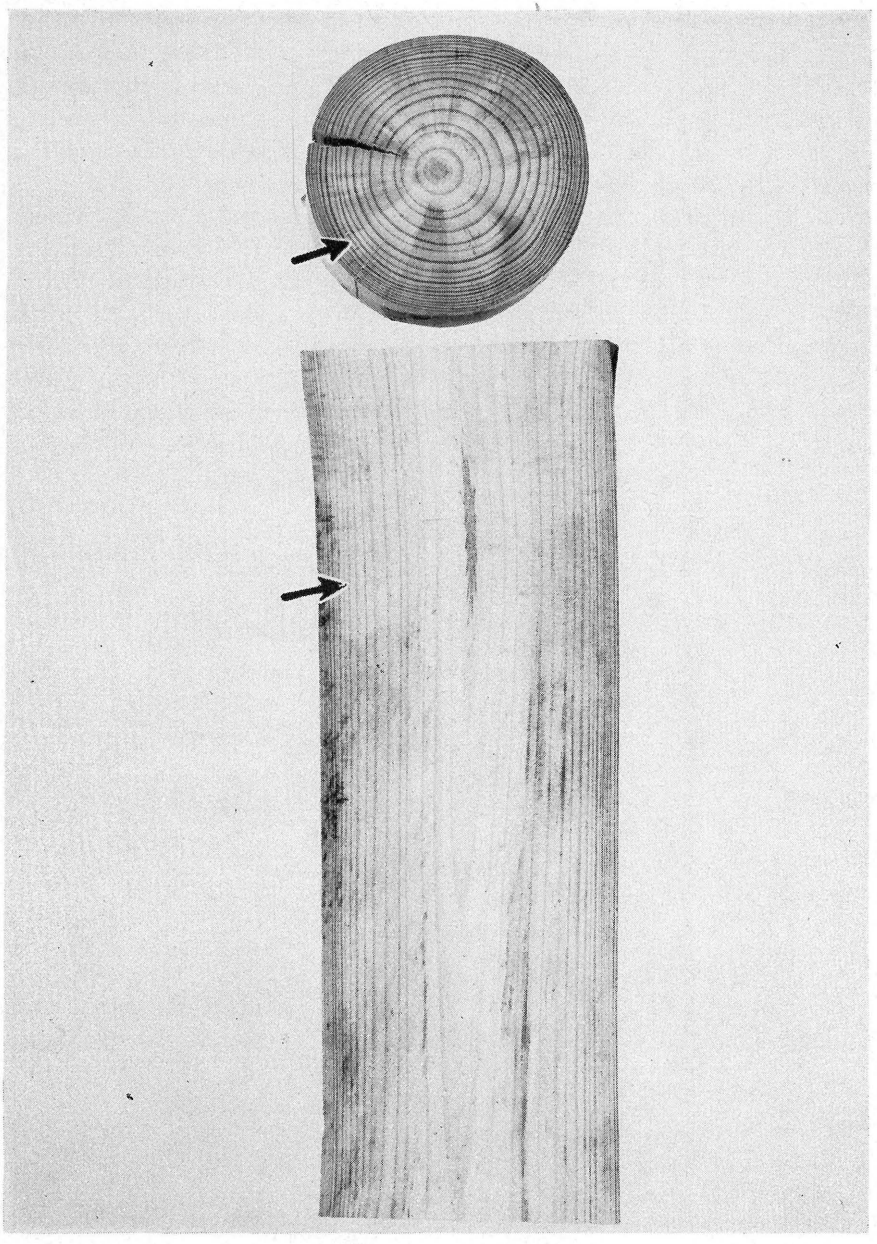

Fig. 2.—Red pine post. The depth of penetration has been restricted by inner bark and aided by insect holes. Arrows indicate areas of reduced penetration of preservative.

The method of peeling had some effect in deviation from the mean. Sap-peeled posts in three of the four charges were fairly uniform in retention. Since the posts were soaked until there was no further uptake, it appears that more uniform results can be obtained by sap peeling posts to be cold soaked than by other methods. The deviation from the means of the hand-peeled posts is not large and any generalization based on the results of this test as to difference between hand- and sap-peeling as a factor in retention and penetration of preservatives by cold soaking is not valid. However, when total retention and penetration is examined these posts did not retain sufficient amounts of preservative nor is sapwood penetration deep enough to insure long service life.

Some of the white pine posts contained reaction wood which presented a barrier to the penetration of the preservative, as shown in Figure 3. Posts of both species had been removed as thinnings from

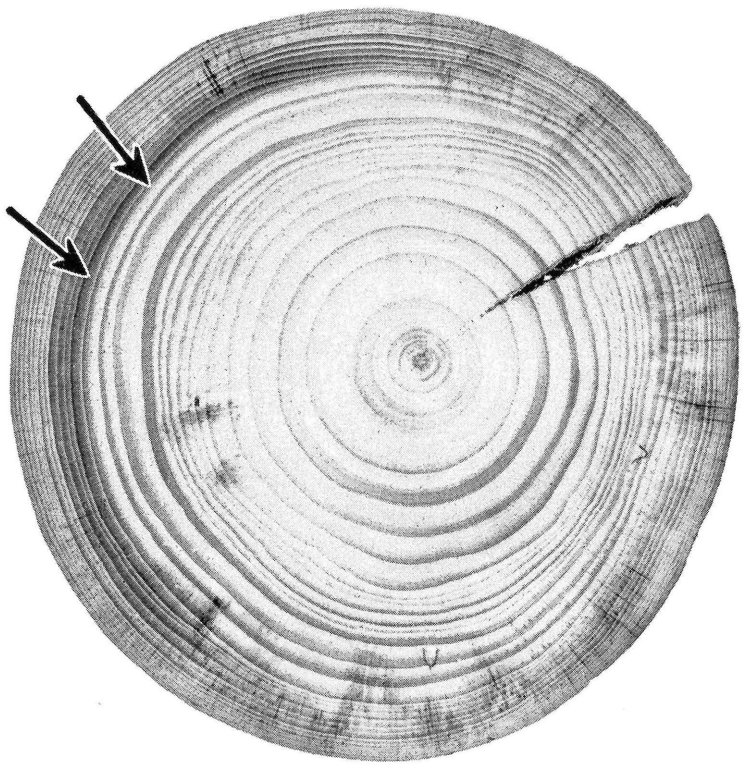

Fig. 3.—White pine. Penetration has been restricted by reaction wood. Reaction wood is abnormal wood elements formed on underside of leaning trees.

plantations. The growth had slowed considerably. Consequently the posts had from 6 to 10 annual rings in the outer inch. The red pine posts in which penetration of sapwood was one hundred percent did not have over an inch of sapwood.

In order to examine adequacy of this method of treatment the percentage of acceptable posts was calculated using the following formula:

$$\frac{L - X}{S} = Z \quad \text{where } L = \text{limit}$$

X = mean
S = standard deviation
Z = point on absisca of normal curve

The lower limit is the retention at which satisfactory service life may be expected. The upper limit is the retention at which the post costs would be higher than service life as determined by competing methods, competing type of posts, or replacement costs would justify.

These limits are arbitrarily set at 4 pounds per cubic foot, and 12 pounds per cubic foot, respectively. The upper limits will vary because of individual raw material, labor, and treatment expenses. Table 2 lists these percentages of posts falling below or above these limits by species, preservative, and method of peeling.

This table shows the total percentage of posts which are between the limits imposed. The posts which retained less than three pounds per cubic foot do not have sufficient preservative to be above the lower

TABLE 2.—Percentage of Posts Acceptable

Species	Peeling	Copper Naphthenate				Pentachlorophenol			
		Mean	Percentage		Total	Mean	Percentage		Total
			Lower	Upper			Lower	Upper	
Red pine									
	Bug	12.62	____	30.0	70.0	12.40	0.9	45.5	53.6
	Chemical	6.38	20.0	0.8	81.2	5.83	____	7.0	93.0
	Sap	3.75	0.5	____	0.5	3.96	63.0	____	63.0
	Hand	3.61	30.8	____	30.8	4.40	68.5	____	68.0
White pine									
	Bug	4.75	37.5	0.1	62.4	4.26	46.2	0.6	75.2
	Chemical	4.67	30.2	____	69.8	5.16	31.6	0.2	68.2
	Sap	2.07	0.1	____	0.1	1.94	____	____	____
	Hand	1.87	____	____	____	2.06	0.1	____	0.1

limits. The posts with mean retentions below four pounds per cubic feet and small deviations around this mean have a small number of acceptable posts. The use of these limits enables the evaluation of the time of soak and method of peeling. It can be seen that hand and sap peeled red and white pine posts soaked to refusal have not retained sufficient preservative. Those treatments in which less than 60 percent of the posts are between the limits may be considered unsatisfactory, for the increased service life of some of the posts of a charge will be reduced by replacement of the remainder of the posts in that charge.

The retentions of the white pine, bug- and chemically-peeled posts is considerably less than the indicated retentions. These posts bled after their removal from the solution and since deviation from the mean is large, many of the posts are outside of the limits. A longer soaking time would reduce this percentage, however because of the limits set by the experiment the charge was pulled when the desired retention was reached.

Conclusions and Recommendations

From the results of this study and other studies conducted at the Ohio Agricultural Experiment Station the following conclusions may be drawn:

1. Although insect-attacked posts are easily treated, the variation caused by the difference in degree of insect activity plus the danger of serious fungal activity in the post during peeling justifies rejection of the bug-peeling method.

2. Because of wide range in length of time the posts were soaked and resultant retentions and penetrations, time of soak is not an adequate measure of satisfactory treatment, however, the volumetric or quantitative method provided a more reliable means of determining when posts are to be removed from the treating solution.